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THE CHOLERA SITUATION.

There has been no material change in the cholera situation during the past week.

OBSERVATIONS ON THE VIABILITY OF THE EGGS OF HOOKWORMS (*Necator americanus*) AND OF EELWORMS (*Ascaris lumbricoides*) IN FECES ALLOWED TO DECOMPOSE IN WATER.

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In the summer of 1910, a series of experiments¹ was begun at the United States marine hospital, Wilmington, N. C., to test the viability of eggs of parasites, especially of hookworms, under certain conditions which come into consideration in connection with preventing the spread of intestinal zooparasitic diseases.

Circumstances beyond our control excluded the possibility of examining the experimental material at stated intervals, but the results obtained appear to give definite and instructive clues of considerable importance in respect to the viability of hookworm eggs and *Ascaris* eggs.

As pointed out in an earlier article, work of this kind in connection with animal parasites is of somewhat different nature from the corresponding work with bacteria.

The following experiments were reported upon, in part, in former papers by Stiles and Gardner. The object of the tests was to determine how long the eggs could live in water containing a considerable quantity of fecal material.

Experiment 17.—In an earlier paper it was reported that in this experiment fecal material containing eggs of *Ascaris* and *Necator* was placed (June 22, 1910) in a bucket of water, and that after 144 and 149 days 30 hookworm eggs and 5 *Ascaris* found were dead.

The bucket was allowed to stand from November 13, 1910, to July 12, 1911, at room temperature, water being added occasionally to replace the water that evaporated. On July 12, 1911 (385 days after

¹ See Public Health Reports, Vol. XXV, No. 27, July 8, 1910, pp. 947-950; No. 33, Aug. 19, 1910, pp. 1137-1140; No. 30, Dec. 16, 1910, pp. 1825-1830. This series of experiments was begun by Stiles and Gardner; owing to illness, Surg. Gardner has been unable to continue the work.

starting the experiment), the sediment was examined microscopically and 55 hookworm eggs, 1 *Ascaris* egg, and 2 *Hymenolepis* identified. All were dead.

Experiment 27.—Fecal material containing eggs of *Ascaris* and of *Necator* was placed (July 20, 1910) in a bucket of water. It has already been reported that on November 14, 1910, 20 hookworm eggs and 34 *Ascaris* eggs were found and that all of the former and 29 of the latter were dead, while 5 *Ascaris* eggs may possibly have been alive.

On July 12, 1911 (357 days after starting the experiment), 70 hookworm eggs and 50 *Ascaris* eggs were identified. All were dead.

Experiment 31.—On August 3, 1910, a quantity of human feces, containing hookworm eggs, was placed in a bucket of water and allowed to ferment.

On November 13, 1910, some live and some dead male and female nematodes (genus undetermined) were found to be present. Whether these worms represented a contamination or the free stage of some undescribed intestinal parasite remains uncertain.

On July 18, 1911 (349 days after the beginning of the experiment), 60 nematode eggs found were all dead. It is not excluded that some of these eggs were not those of hookworms, but the fact that all were dead justifies the recording of the experiment.

Experiment 32.—Fecal material was placed (August 13, 1910) in a bucket of water and allowed to stand at unheated room temperature until November 12, 1910. On November 13, 1910, 20 slides showed 4 dead hookworm eggs and the infection had thus apparently died out in 68 days.

On June 26, 1911 (317 days after the experiment was started), the material was passed through a sieve and a portion of the top fluid was centrifuged; 4 slides were negative.

After settling, the top and middle portions were centrifuged with negative findings.

The fluid was allowed to settle over night and the sediment was examined. About four hours' search gave 13 thin shelled nematode eggs (all dead), 1 dead embryo (unidentifiable), and a fragment of 1 dead male small nematode (unidentifiable). Whatever species of nematode may have been represented by the findings, it seems clear that 317 days after the experiment was started, live hookworm eggs could not be found.

Experiment 33.—Fecal material was placed (Sept. 7, 1910), in a bucket of water and allowed to stand at unheated room temperature until November 12, 1910. Microscopic examinations on November 12, 13, 16, and 17 showed a large number of dead hookworm eggs, but 2 were found which were probably alive and 2 were found (Nov. 16) which were undoubtedly alive. A *Hymenolepis nana* egg was probably dead.

A portion of No. 33 was transferred (Nov. 13) to sterilized sand and incubated until November 21. Examinations made November 20 and 21 showed 31 hookworm eggs, of which 30 were surely dead, 1 probably dead. A *Hymenolepis nana* egg may have been dead, but this is uncertain. One *Ascaris* egg was dead; 2 were doubtful.

On July 27, 1911 (323 days after the experiment was begun), 70 hookworm eggs were identified in experiment 33. All were dead.

Experiment 45.—February 6, 1911, a bucket of fecal material containing eggs of hookworms and *Ascaris* was placed in a barrel of water and left exposed to the sun and rain. The special object in using the barrel was to place the eggs in about the same quantity of water used in an LRS privy.

June 30, 1911, a portion of the sediment was passed through a series of sieves, then sedimented and centrifuged. After a very tedious microscopic examination 60 hookworm eggs and 10 *Ascaris* eggs were found. All the hookworm eggs were dead; 9 of the *Ascaris* eggs were dead, 1 probably dead.

The experiment indicates that in an LRS privy the hookworm eggs can not survive 144 days of fermentation in water.

Summary.—From the foregoing experiments and those published by Stiles and Gardner it may be seen that in fecal material kept in water, in the examinations made after 68, 117, 144, 317, 323, 349, 357, and 358 days, all the hookworm eggs identified were dead.

The longest period of time after which we have thus far been able to find live hookworm (*Necator americanus*) eggs under the conditions described has been 70 days.

The longest periods after which we have thus far been able to find live eelworm (*Ascaris lumbricoides*) eggs under the conditions described have been 117 to 121 days. After 144 days 2 *Ascaris* eggs were found, in regard to which some possible doubt exists, but they were probably dead.

It therefore seems fairly well established that fermentation for four months in an LRS privy kills all the hookworm eggs and that fermentation for three months (as suggested by Stiles and Gardner) will kill nearly all, probably all, the hookworm eggs.

These conclusions are based upon conditions obtaining in eastern North Carolina.